ON THE DISTANCES OF RED STARS.

(Abstract.)

By HENRY NORRIS RUSSELL.

(*Read April 23, 1910.*)

Comparison of the parallaxes of stars, derived by the writer from photographs taken at the Cambridge Observatory (England) by Mr. A. R. Hinks and himself, and their spectra, determined at Harvard under the direction of Professor Pickering, shows a marked correlation between spectral type and parallax.

If the stars observed are divided into four groups: (1) Those chosen at random for comparison purposes in fields near the Milky Way, (2) similar stars remote from the Galaxy, (3) stars of considerable proper motion, (4) those shown by observation to be relatively very near us (parallaxes greater than 0".10); then the percentages of stars of the different spectral types in these groups are as follows:

Group.	Color Spectrum.	White.		Yellow,	Orange,	Red.
		A	F	G	K	M
1		30%	25%	19%	26%	
2		6	19	42	29	4%
3				50	38	12
4				10	60	30

The percentage of orange and red stars increases steadily with increasing nearness of the group to our system.

Conversely, if the observed parallaxes of the stars of considerable proper motion are compared with the predictions of Kapteyn's formula, it is found that the means for groups including all spectral types are closely represented, but that the means by spectral types show marked systematic deviations, as follows:

Spectrum.	Number of Stars.	Mean Parallax.		Ratio.
		Observed.	Formula.	
F8	3	0″.042	0″.079	0.5
G	7	0″.029	0″.104	0.3
G5	2	0″.041	0″.098	0.4
K	4	0″.119	0″.103	1.2
K5	5	0″.253	0″.141	1.8
M	3	0″.220	0″.108	2.0

As all the stars under consideration lie within the same limits of apparent brightness, it follows that they are intrinsically fainter the redder they are. The reddest average only one fiftieth as bright as the sun.

On the other hand, it is well known that many bright red stars, such as Arcturus and Antares, are at great distances, and are probably at least one hundred times as bright as the sun.

All this can be explained on the hypothesis (now well established on other grounds) that the reddest stars are the lowest in effective temperature. With the latest data regarding temperature and surface brightness, it appears that the fainter red stars are somewhat smaller, and presumably denser, than the sun, while the brighter ones are very much larger than the sun, and presumably of very small density. The latter class probably represent an early stage in stellar evolution, and the former the latest stage that can be observed. In the intermediate stages the star would be hotter, passing through orange and yellow to white, and back to red as it approaches extinction. On this hypothesis there ought to be two distinct kinds of red and orange stars. The distribution of proper motions among these stars supports this theory, showing that those of given apparent brightness may be divided into two groups—one of intrinsically faint stars relatively near our system, the other of bright stars remote from it.

Princeton University,
April 20, 1910.